



# Incorporation of New Forecasting Tools

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# Outline of Topics

- Operational Air Quality Forecast Model
  - Real Time Ozone Forecast System (RTOFS)
- Meteorological Software Applications
  - FX-Net
  - BUFKIT
- Meteorological & Air Quality Equipment
  - Charlotte & Raleigh Radar Wind Profilers
  - Multi-Level Air Quality Monitoring On A TV Tower

# RTOFS

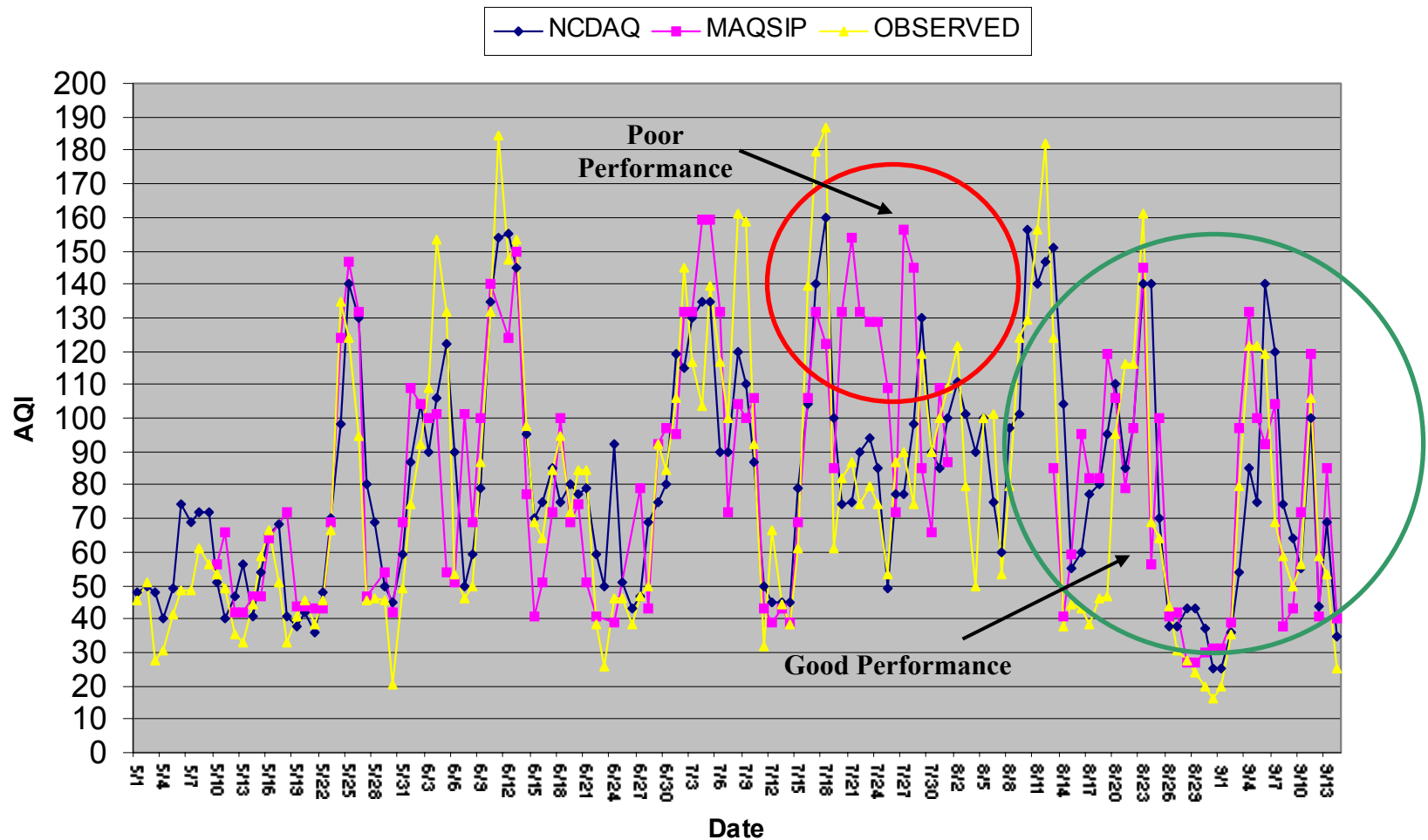
- Real Time Ozone Forecast System (RTOFS)
- Operational AQ Modeling System:
  - Met Model: MM5
  - Emissions Model: SMOKE (*NEI With State Updates*)
  - AQ Model: MAQSIP (*Distant Cousin Of CMAQ*)
  - Automated Generation Of Max Plots & Animations
- Contracted With MCNC (*Now BAMS*)
  - Contract Administrator: John McHenry

# RTOFS

- 2 Daily Cycles Of RTOFS
  - Initialization Off Of The 00Z and 12Z ETA
  - 00Z Cycle Included Day1 Forecast At 15Km & Day1&2 Forecast At 45Km
  - 12Z Cycle Included Day2 Forecast At 15km & Day2 Forecast At 45Km
- Deliverables:
  - 1 & 8 Hour Max Plots For Forecasted Periods
  - Animations Of Ozone During Forecast Periods At The Surface & At An Aloft Layer
  - Wind Vectors Were Added To Animations
  - Various MM5 Output Products

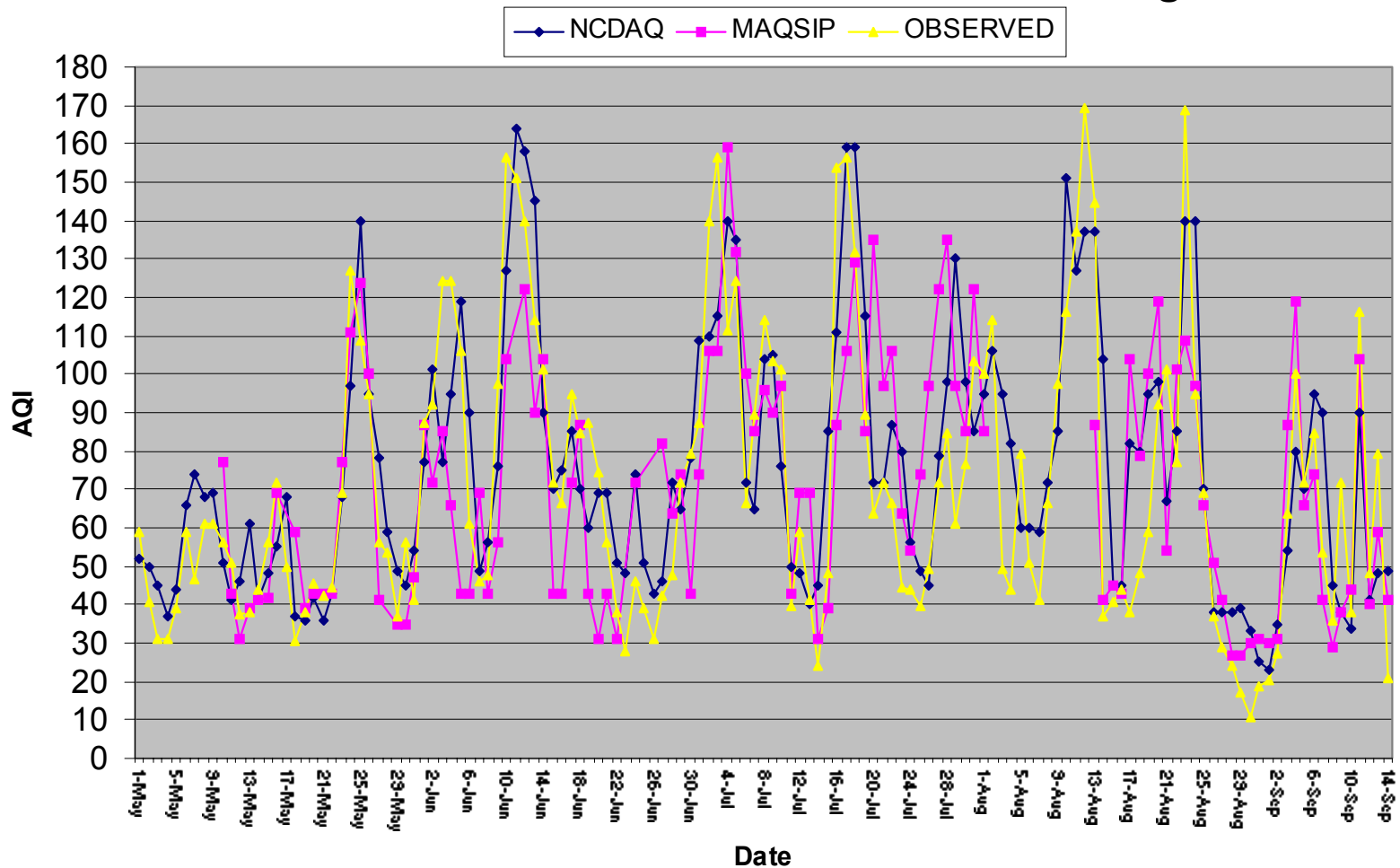
# RTOFS

**AQI: Forecasted vs. Observed for Charlotte**



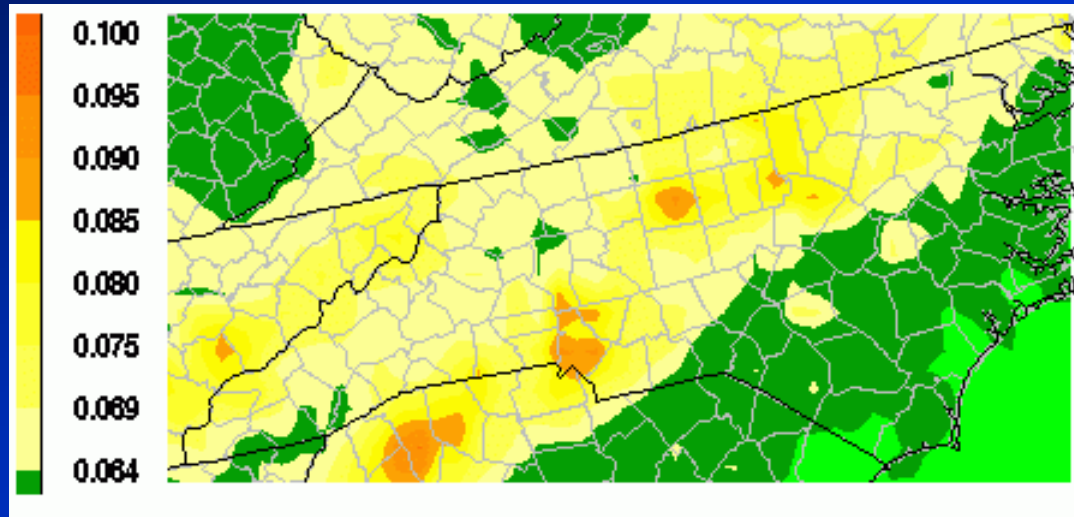
# RTOFS

**AQI: Forecasted vs. Observed for The Triangle**

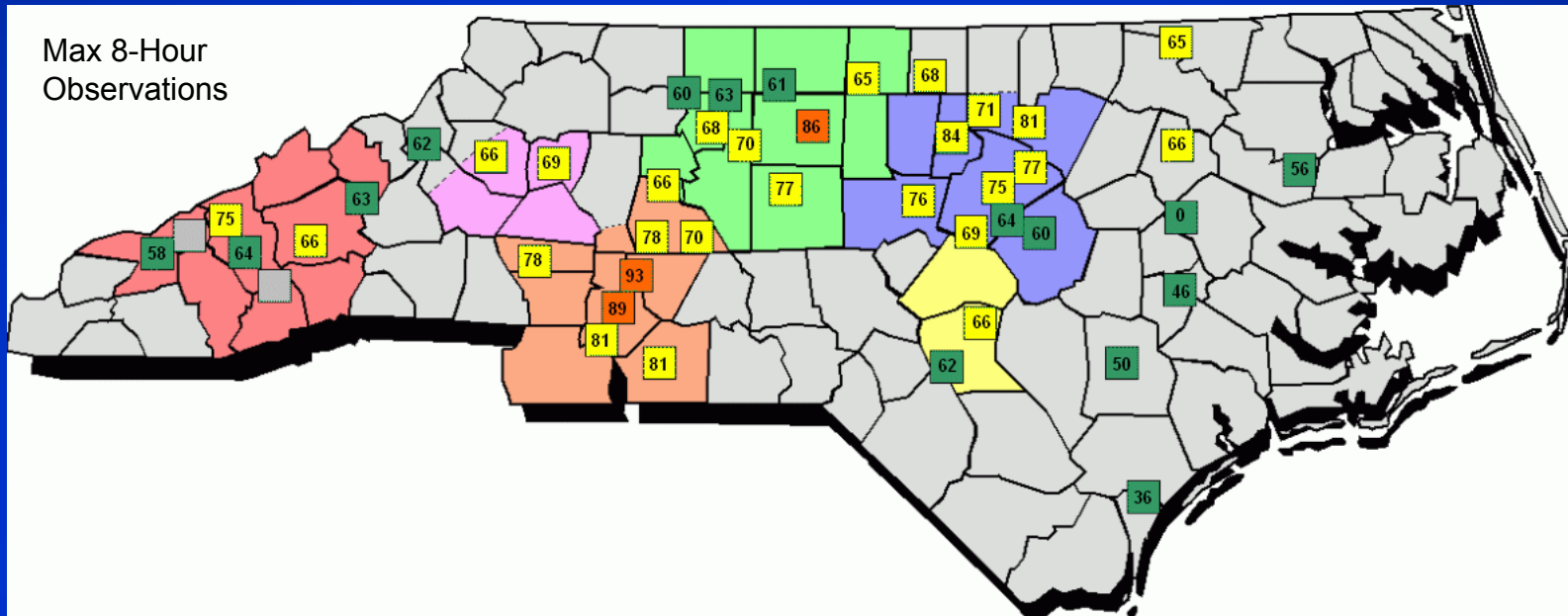


# RTOFS

RTOFS Max 8-Hour  
Forecast (00Z Run)



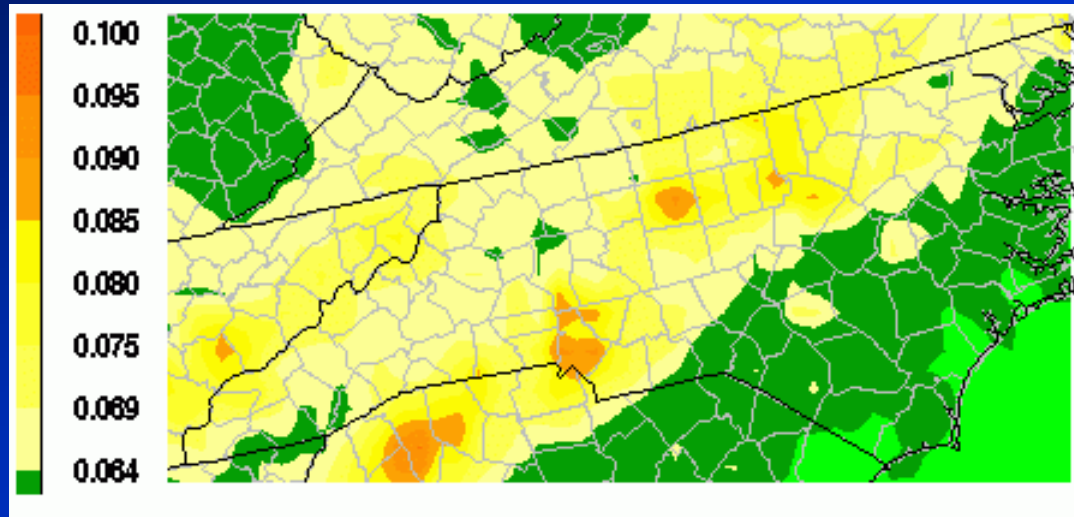
Max 8-Hour  
Observations



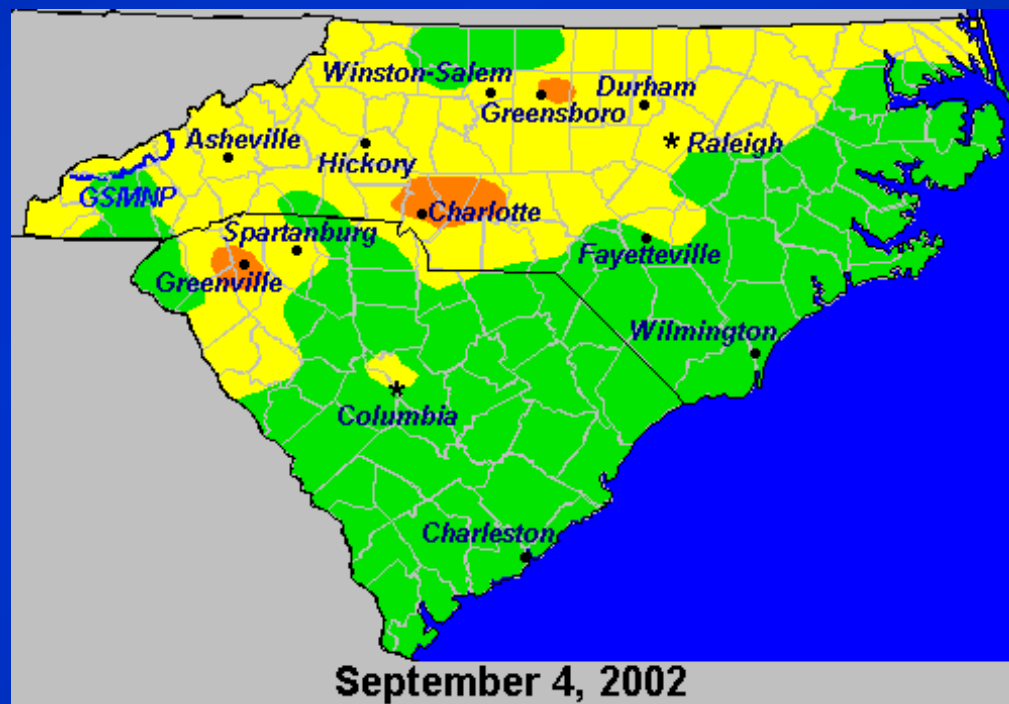


# RTOFS

RTOFS Max 8-Hour  
Forecast (00Z Run)



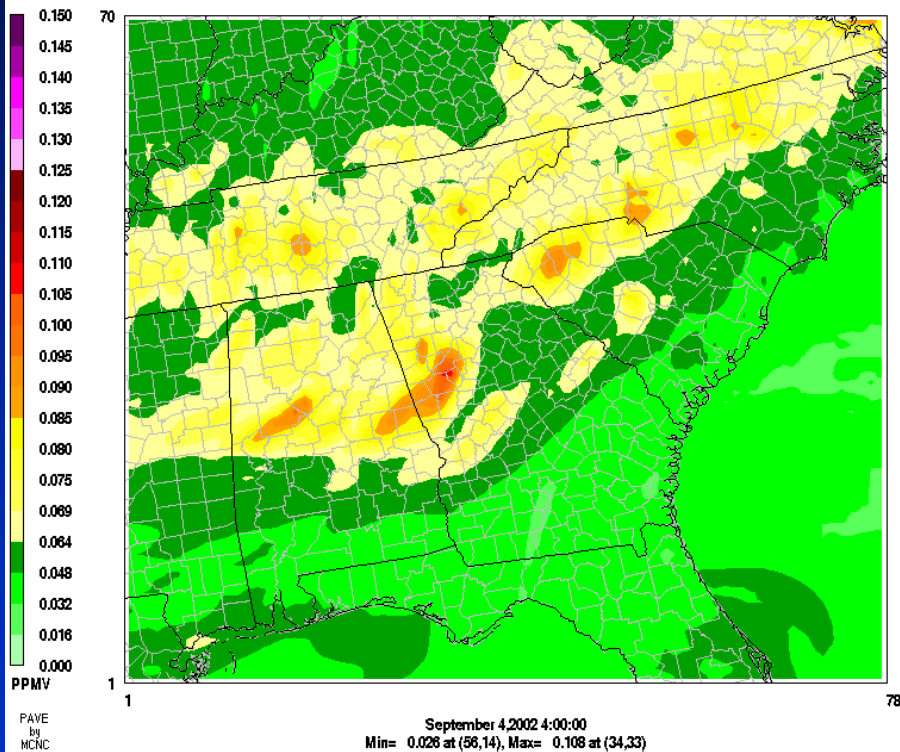
Max 8-Hour  
Observations



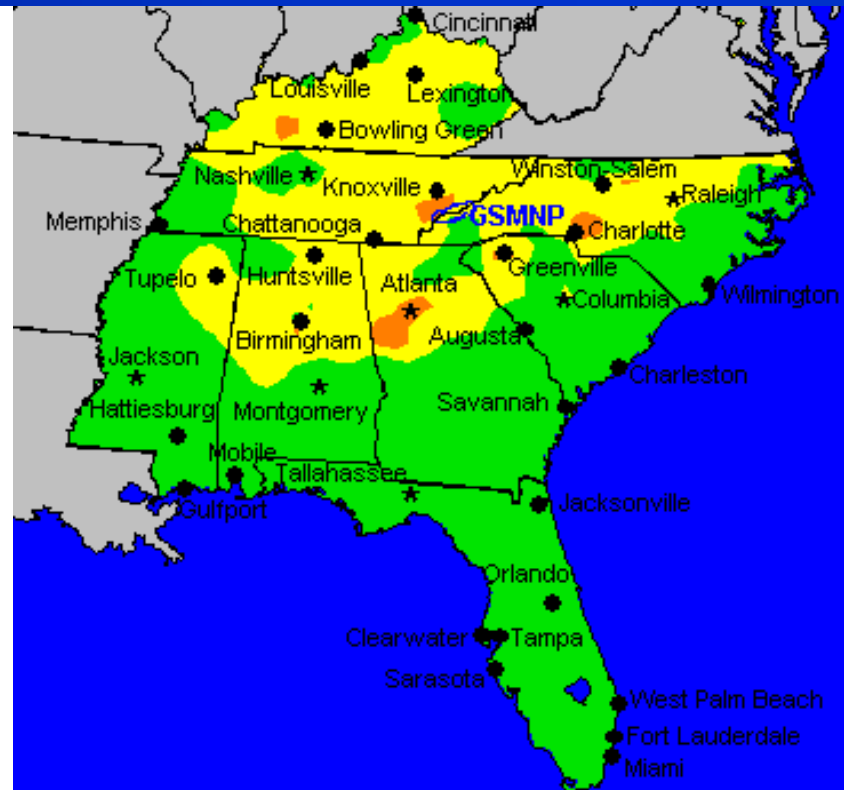
# RTOFS

## 24HR Peak 8HR-AVE Ozone -- SE US

NC DENR and EPA EMPACT 15km  
MCNC Forecast Initialized at: 2002090400



RTOFS Max 8-Hour  
Forecast (00Z Run)



Max 8-Hour  
Observations

# RTOFS

- Multiple Year Effort With MCNC Developing An Operational AQ Model & Incorporating It Into An Operational Forecast Environment
- RTOFS Has Shown Forecast Skill, Which Has Improved Year To Year
- Brief Period Of Real AQ Data Ingest And Initialization In 2002 & Looking Forward To Improvements Of This Process In 2003

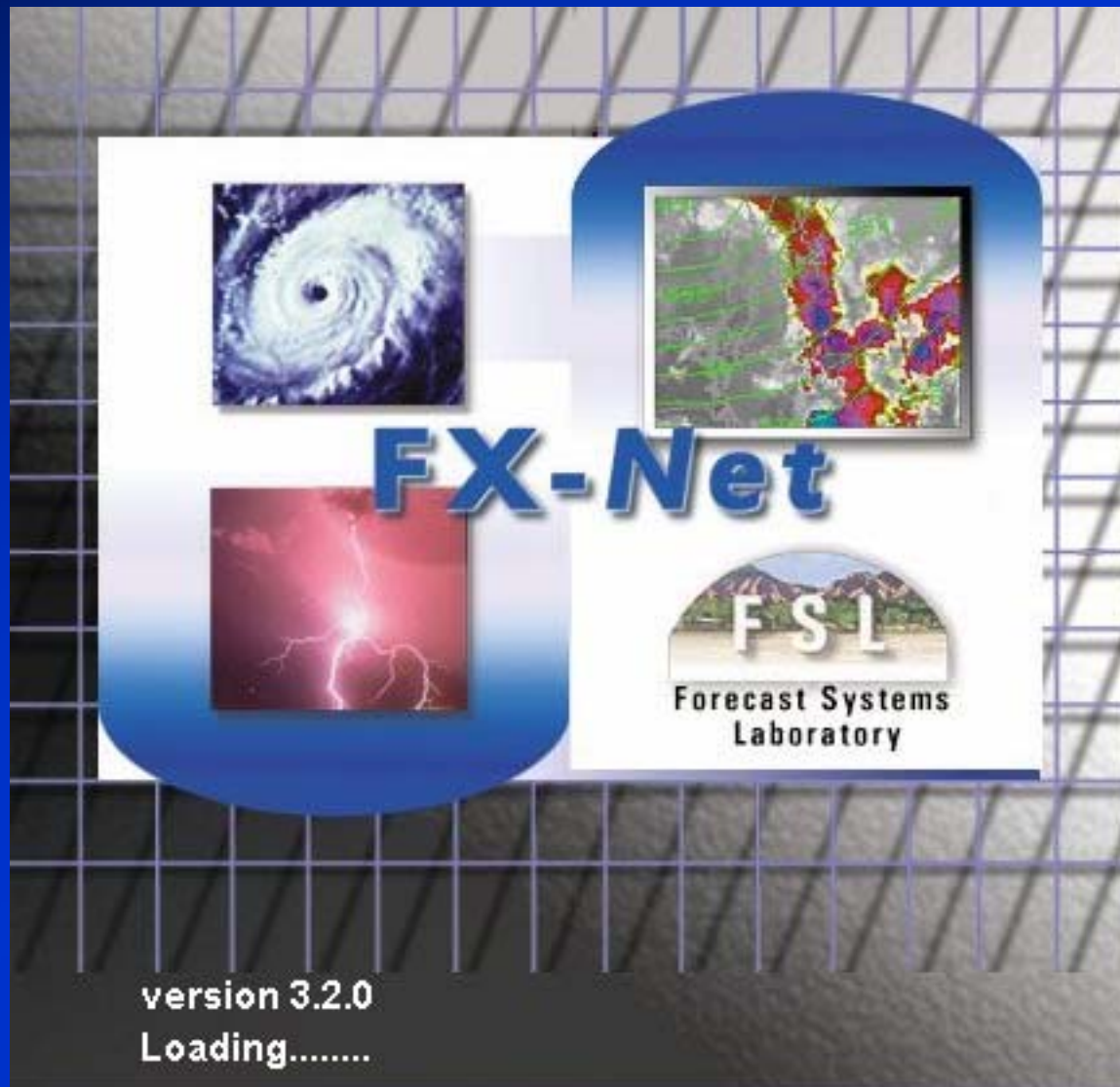
# FX-Net

- AWIPS-Like JAVA Application Developed By NOAA-FSL For Remote NWS Applications
- Allows For Multi-Layer Overlay Of Forecast Model Products, Observational Surface Data, Satellite & Radar Imagery, Even AQ Data...

“A Lot Of Information On One Plot Is Great!” – Mike Gilroy, 2003 NAQC

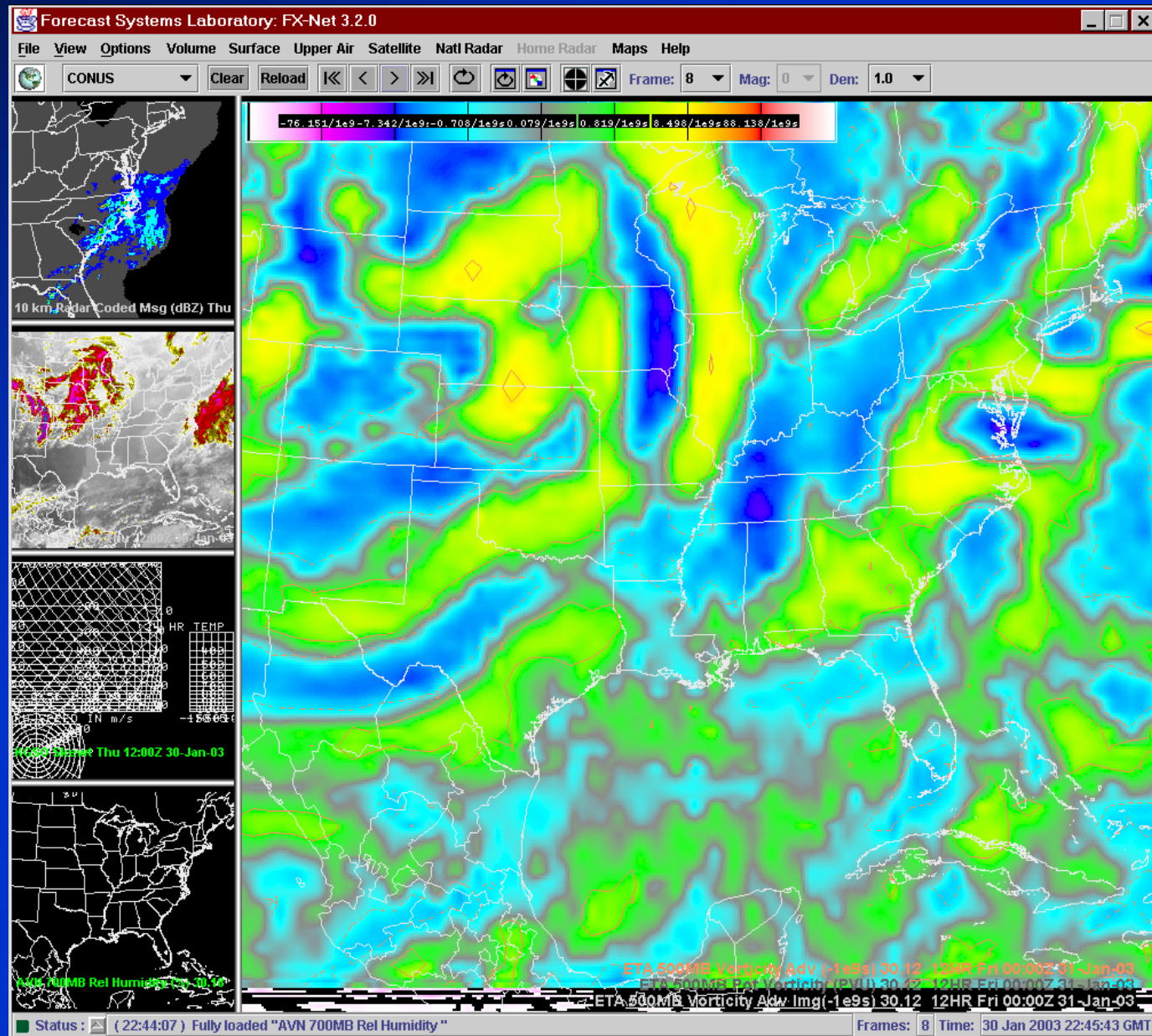
- All Layers Are Time Sequenced And Completely Scalable To Any Region
- Customized Views Can Be Saved

# FX-Net

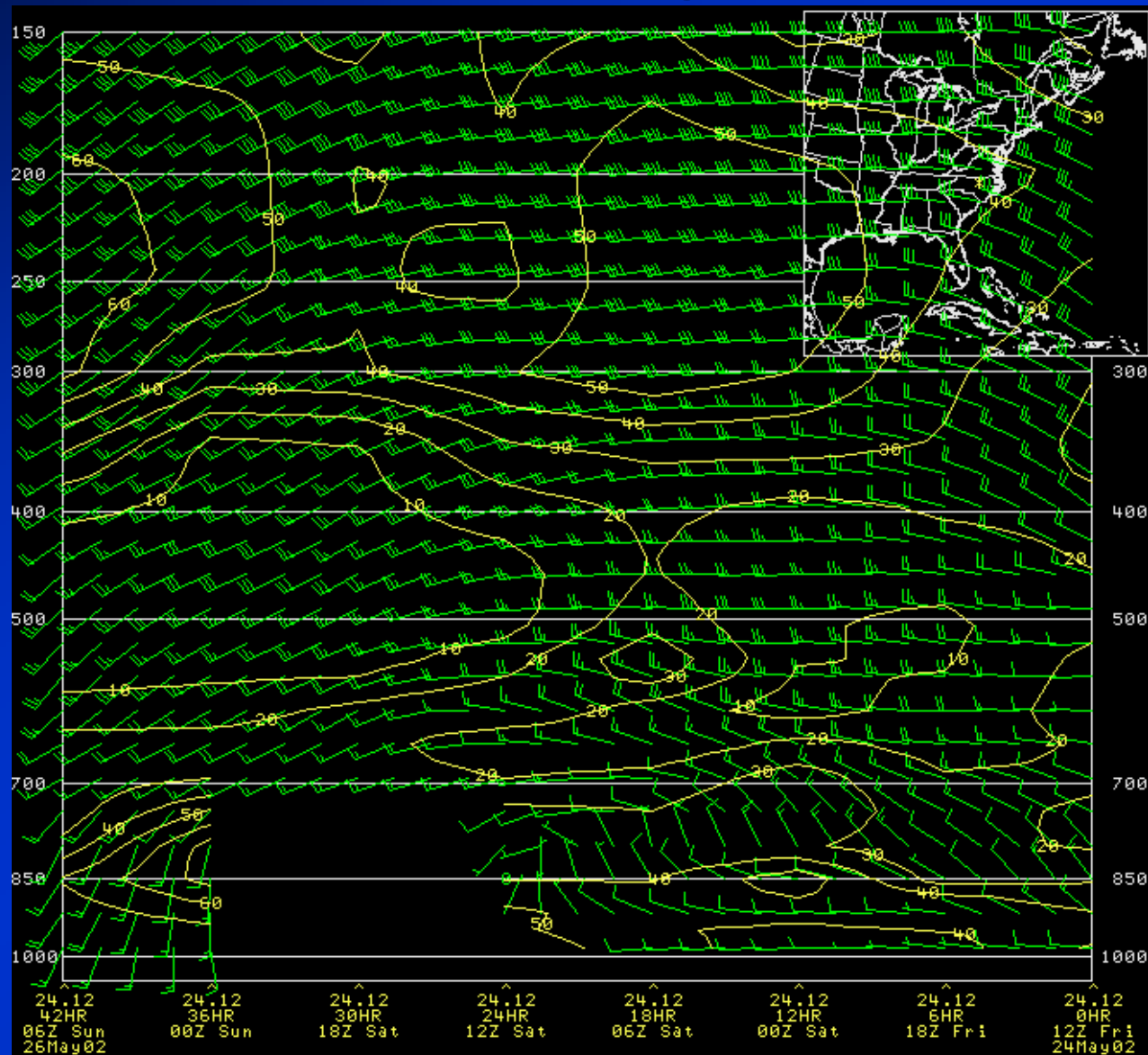




# FX-Net



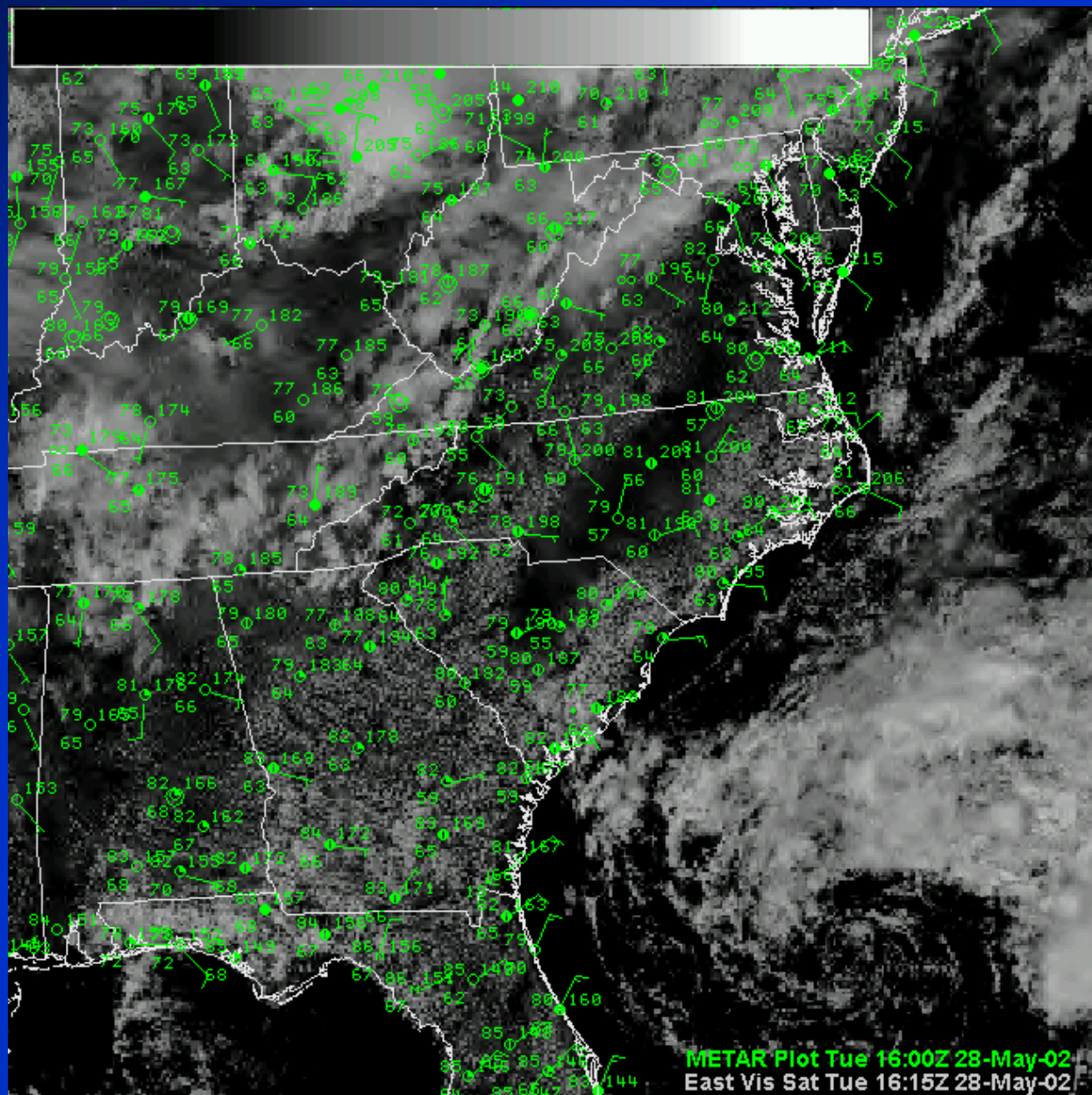
# FX-Net



ETA pointA Rel Humidity 24.12 0HR Fri 12:00Z 24-May-02

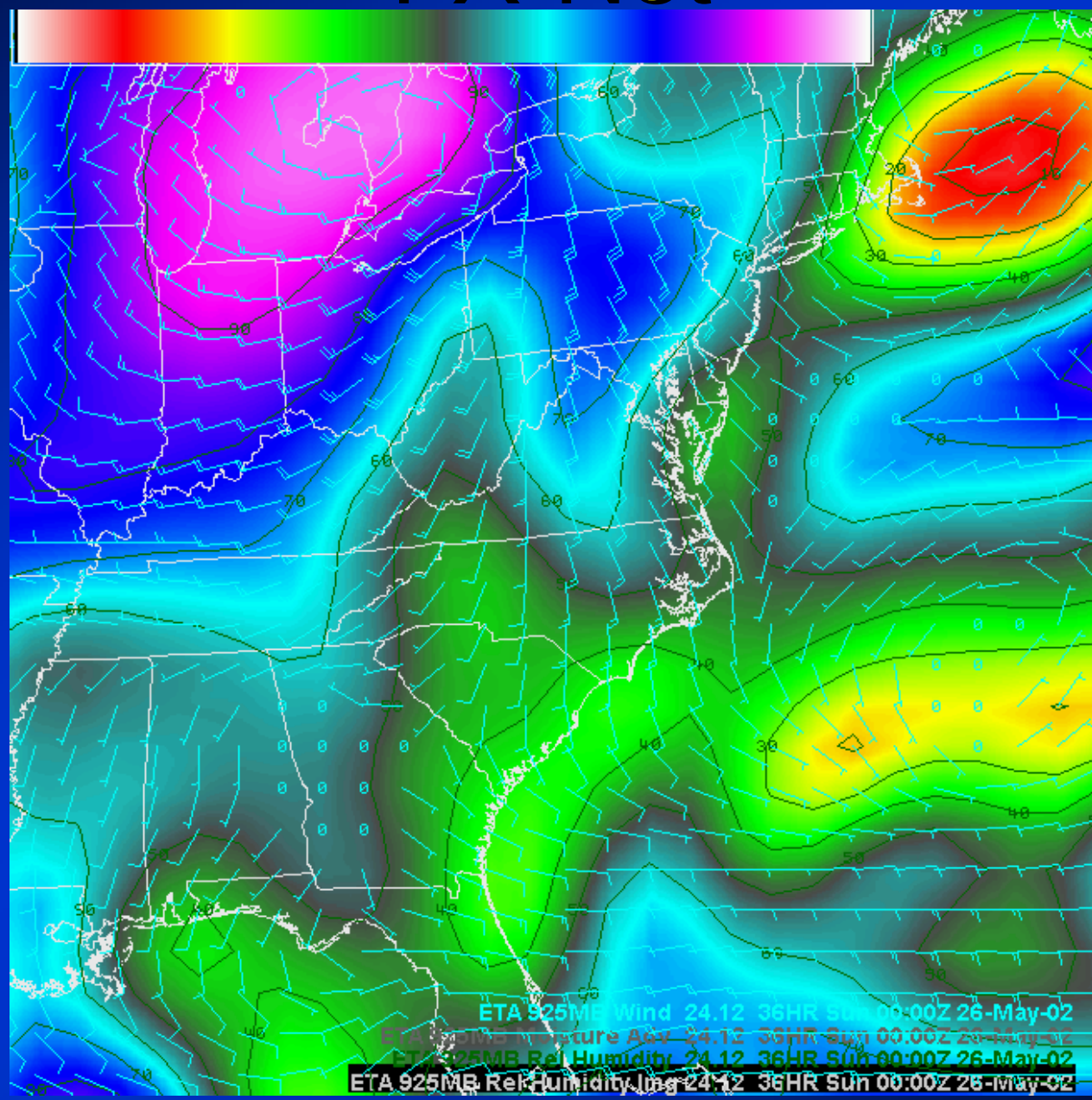
ETA pointA Wind 24.12 0HR Fri 12:00Z 24-May-02

# FX-Net





# FX-Net



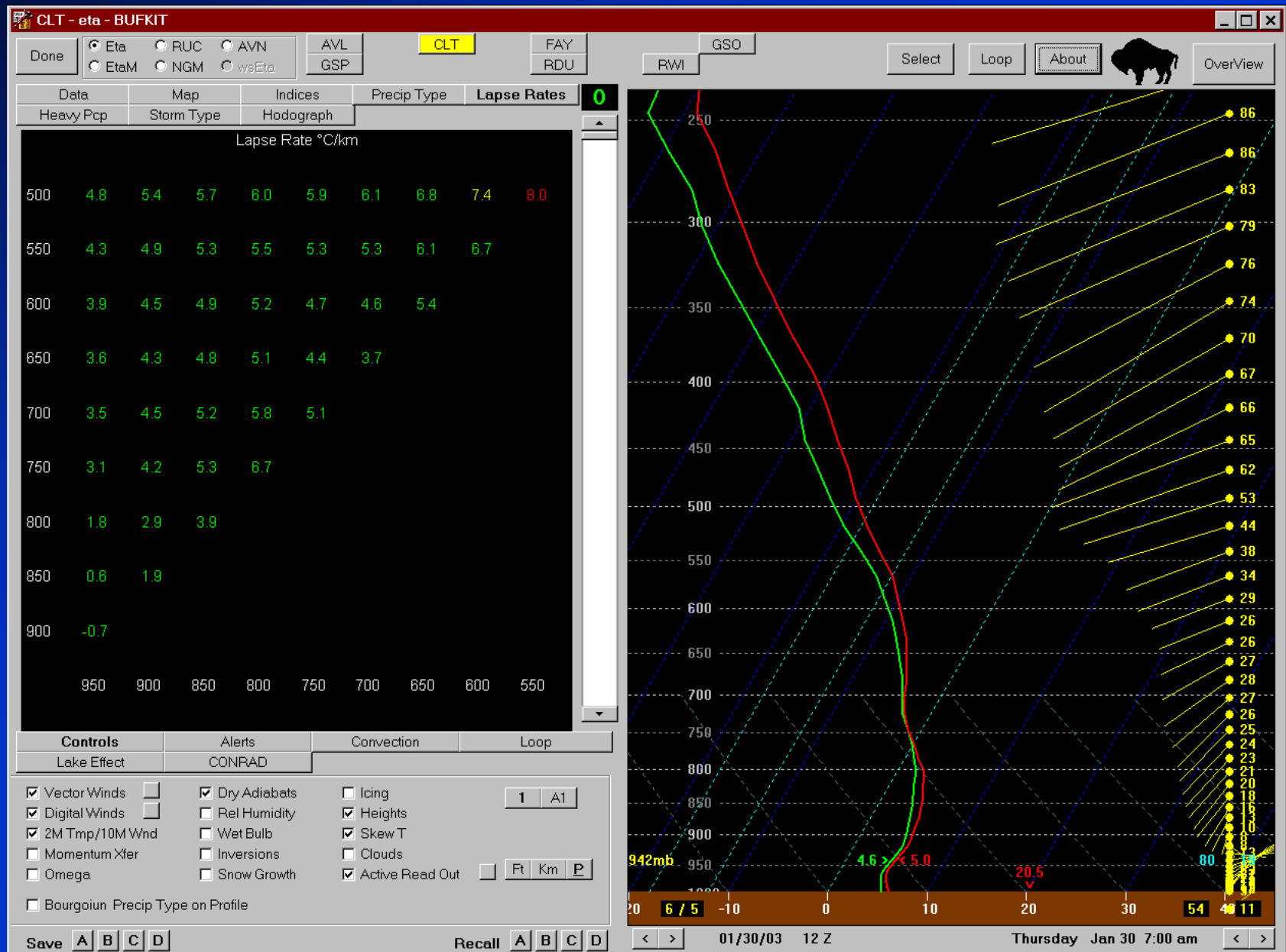
# FX-Net

- This Product Has Tremendous Potential In The Operational Forecasting Environment
- A Lot Of Similar Graphics Can Be Found On The Internet, But We Have Not Found A Place That Offers Such Flexibility And Ease For Alternative Forecast Product Generation
- Issues With Bandwidth & Data Transmission Need To Be Resolved Before FX-Net Can Be Viable For The Larger AQ Forecasting Community

# BUFKIT

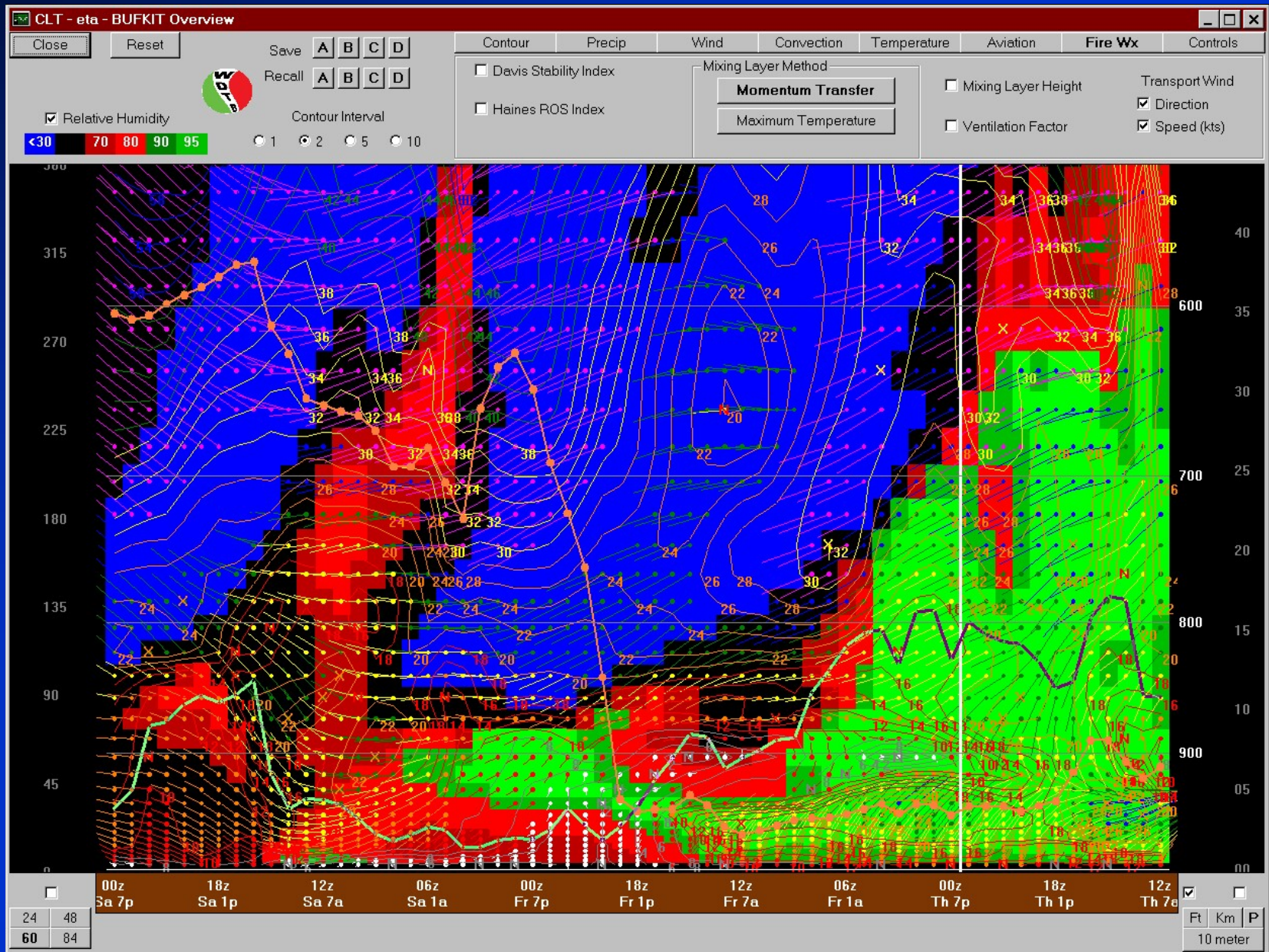
- Excellent Forecast Model Exploration Tool!!!
- Forecast Sounding, Indices, And Other Metrics For A Particular Location
- Vertical Time Series With Thousands Of Possible Parameter Combinations
- Software & Site Data Freely Available
- <http://wdtb.noaa.gov/resources/projects/BUFKIT/index.html>

# BUFKIT





# BUFKIT



# Radar Wind Profilers

- NCDAQ Operates 2 Radar Wind Profilers
  - Charlotte Airport
  - Just SE Of Raleigh
- Technical Specifications:
  - Manufactured By Vaisala ( *Formerly Radian* )
  - 915MHz Units At ~0.5Kw Output Power
    - Lower Boundary Layer Applications
  - Configured For Half-Hourly Winds
    - ~3Km @ 60m Resolution
    - ~5Km @ 100m Resolution
  - Radio Acoustic Sounding System (RASS)
    - Virtual Temperature Profiles To ~1Km



# Radar Wind Profilers



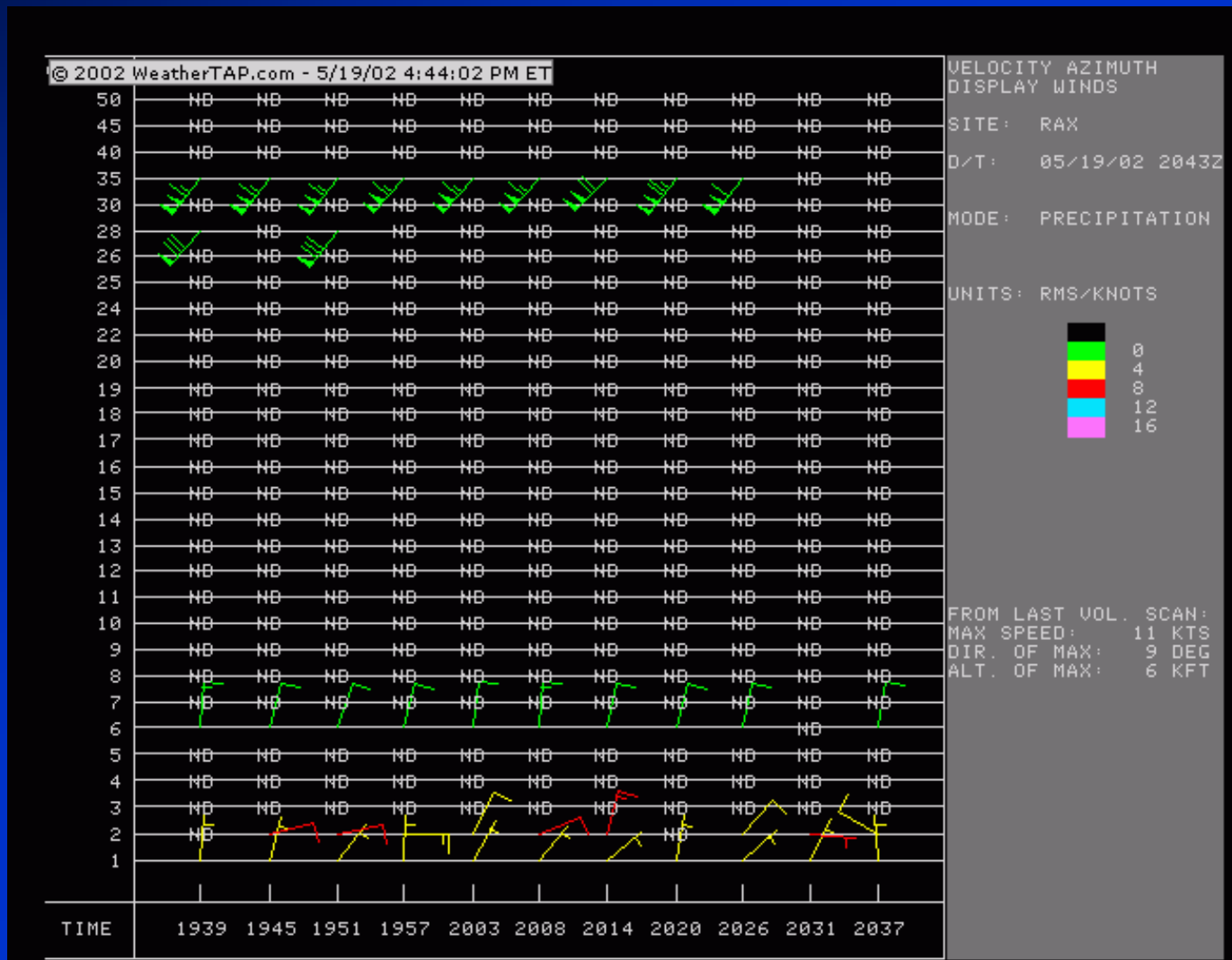
- Example Of Typical Installation ( Raleigh )

# Radar Wind Profilers

- Excellent Source Of Vertical Wind Profiles In Low Reflectivity Or “Clear Air” Atmospheres
- Can Observe Many Micro To Meso-Scale Events:
  - Boundary Layer Growth
  - Re-circulation Patterns
  - Bay Or Ocean Breeze Interactions
  - Nocturnal Temperature Inversions
- Valuable Tool For SIP Modeling

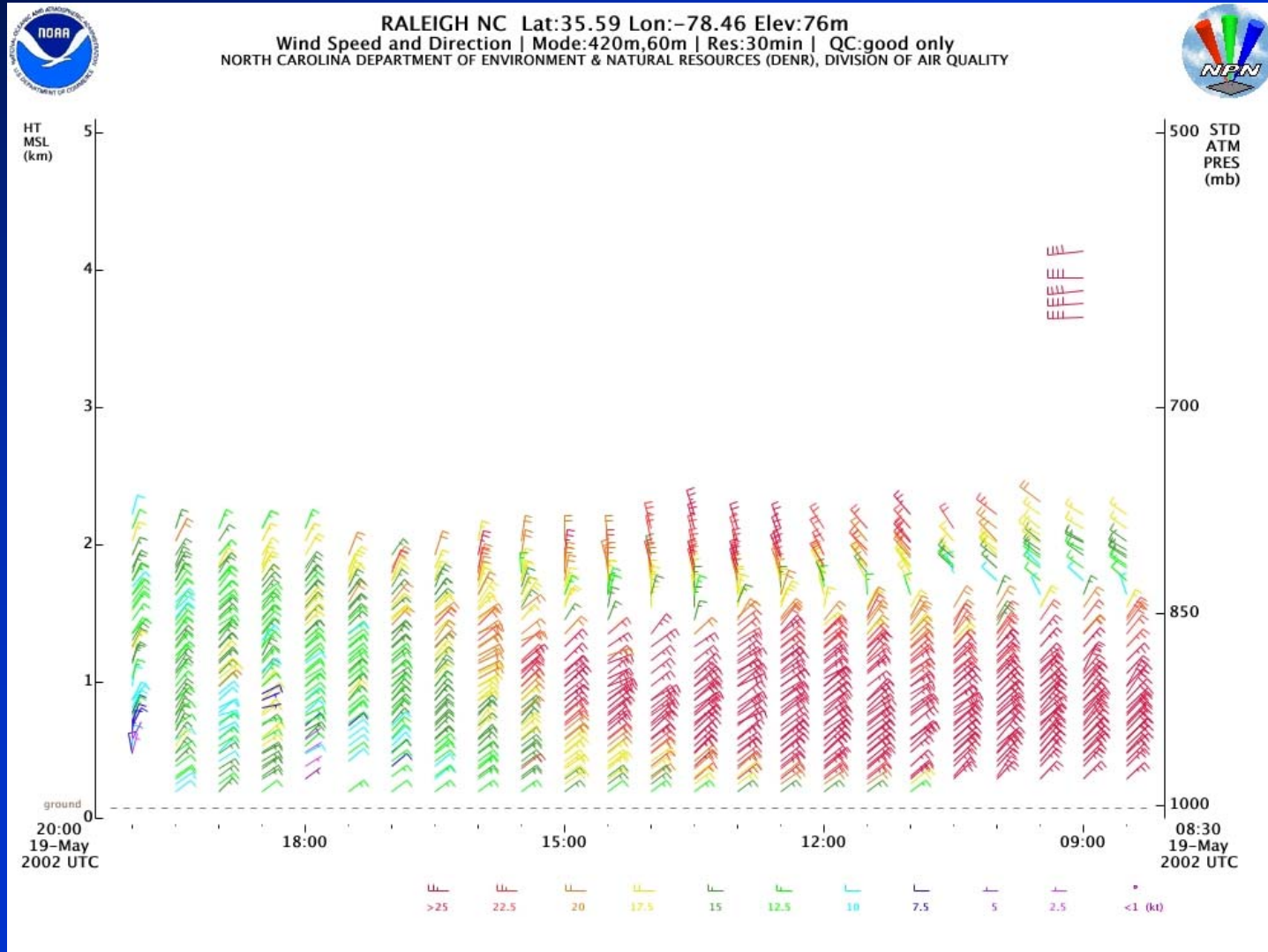


# Radar Wind Profilers



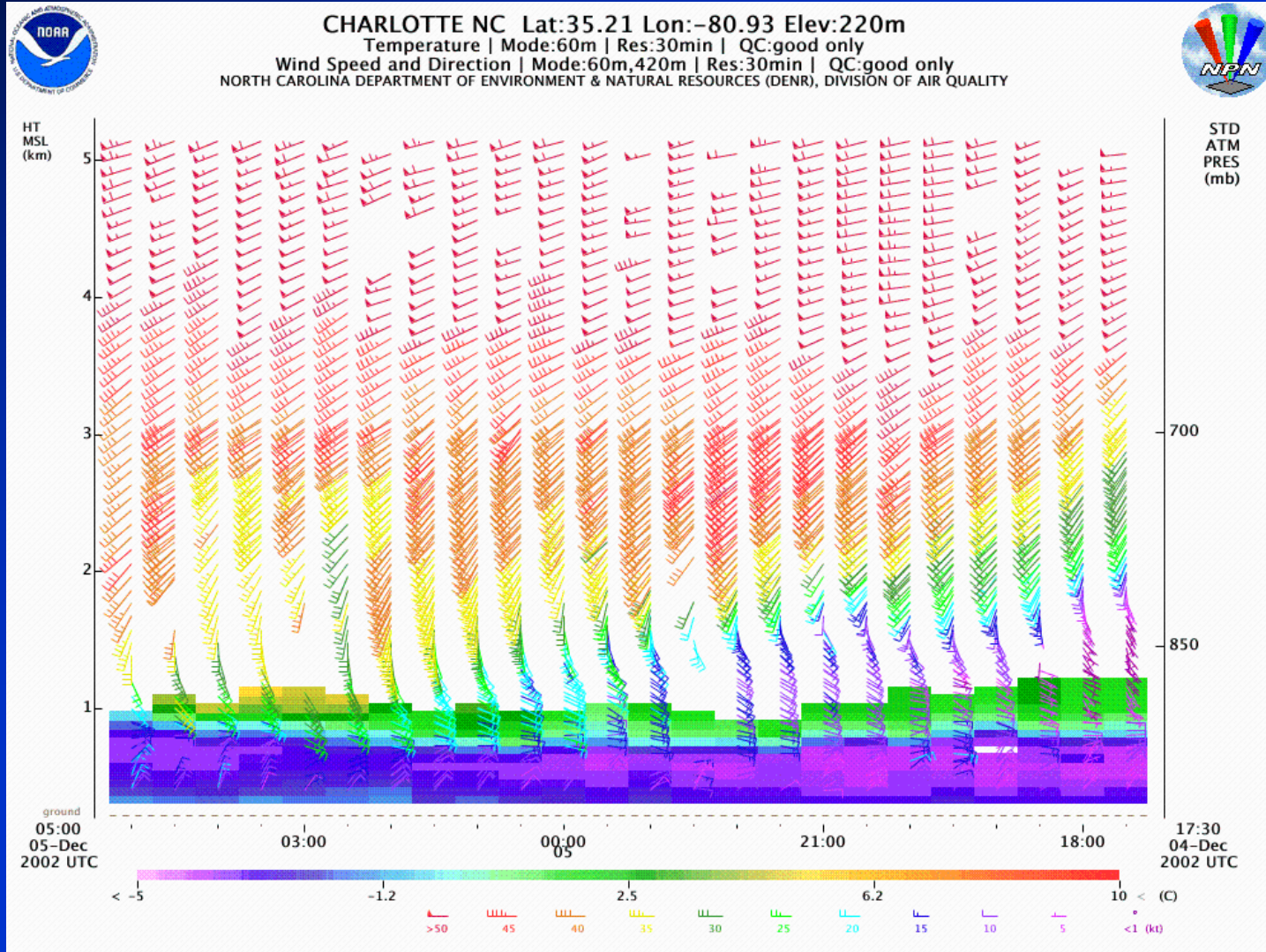
- WSR-88D VAD Product

# Radar Wind Profilers



- Raleigh Profiler Yields Critical Data

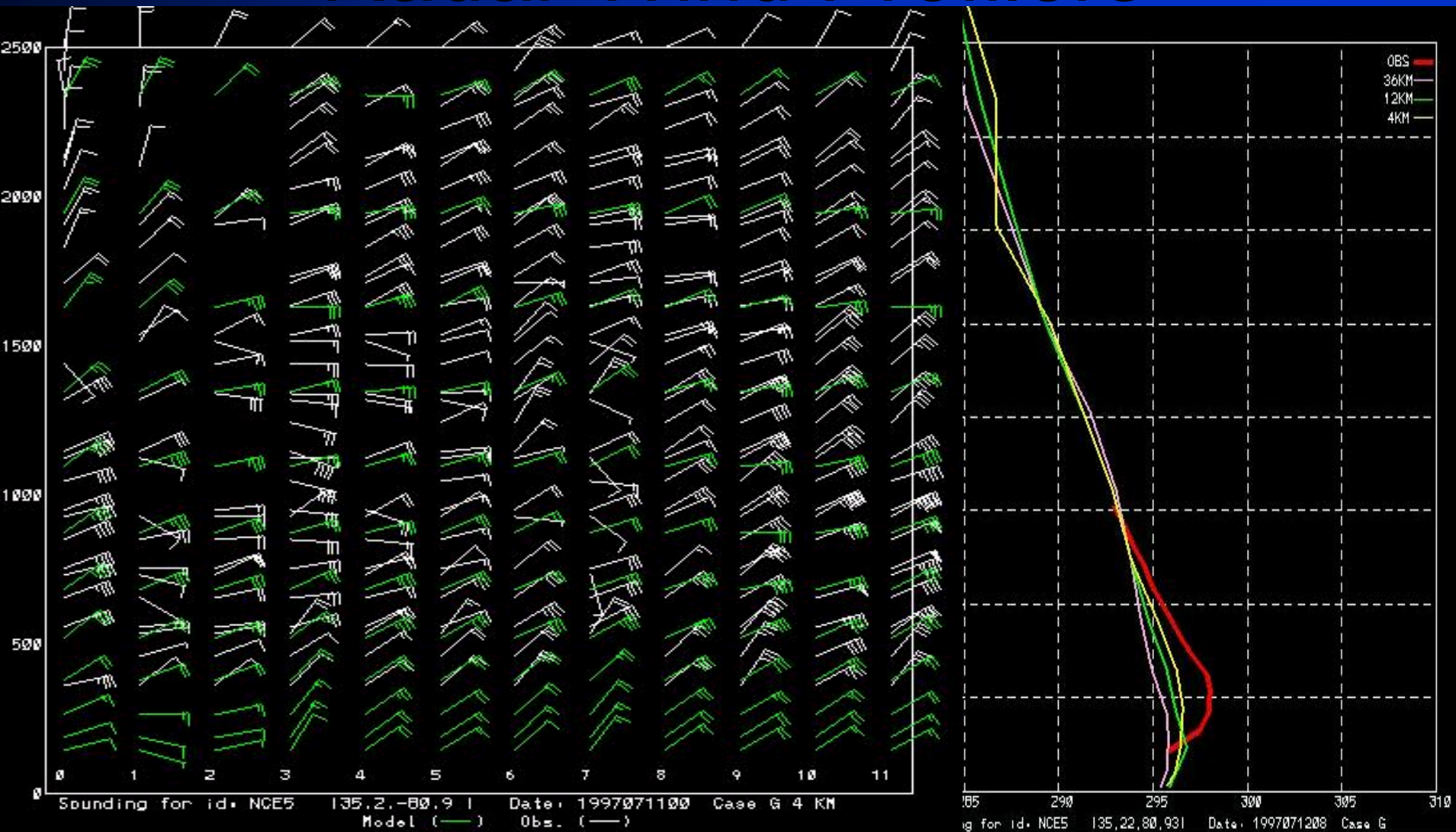
# Radar Wind Profilers



- Low Level Temperature Inversions



# Radar Wind Profilers



- SIP Met Model Verification

# Radar Wind Profilers

- NCDAQ Has Partnered With NOAA-FSL To Make This Data Available To The General Meteorological Community
- More Info On NOAA's Profiler Network:  
<http://www.profiler.noaa.gov/>  
<http://www.profiler.noaa.gov/jsp/profiler.jsp?options=full>

# Multi-Level AQ Monitoring

- NCDAQ Has Operated Ozone Monitors At Multiple Layers On the WRAL-TV Tower Near Raleigh Since 1994
- Hourly Ozone Measurements At The Surface, 250ft, 420ft, and 1420ft
- Unique Site For Forecasting and SIP Modeling Applications
- PM2.5 TEOM Soon To Be Installed!!!

# Multi-Level AQ Monitoring

**Bad Air Quality Day**  
August 9, 2001



**Good Air Quality Day**  
September 27, 2001



- View Of Raleigh From The Tower

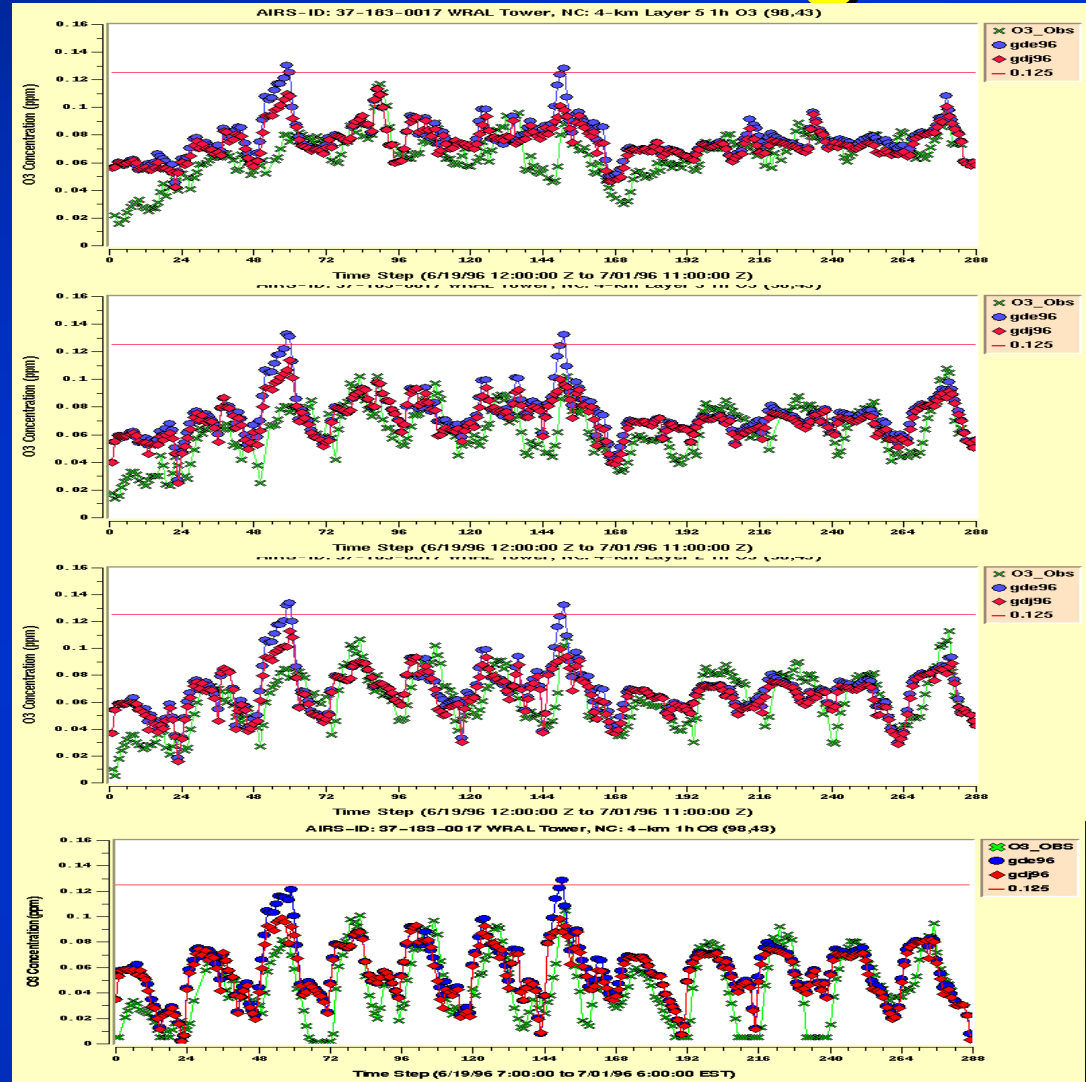
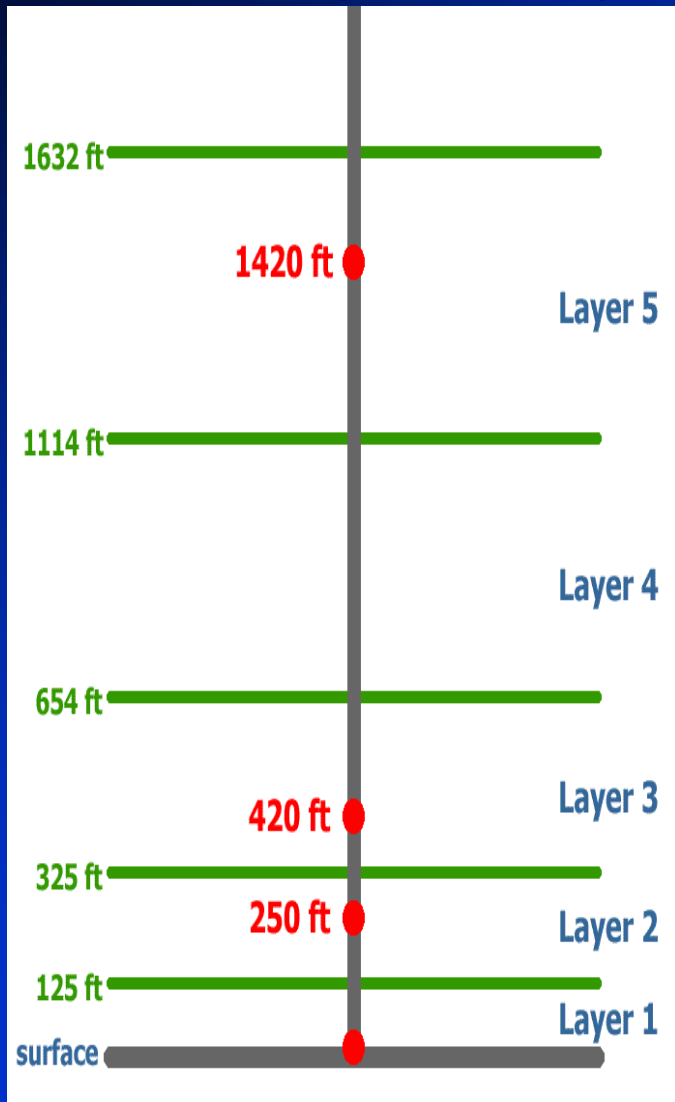


# Multi-Level AQ Monitoring

•	DAILY SUMMARY			08/06/99		218	WRAL TOWER	
•	*****							
•	CHANNEL NUMBER	01	02	03	04	05	06	07
•	CHANNEL NAME	TMP	O3	M2	M4	HI	CAL	IHG
•	-----							
•	01:00	25	.056	.060	.059	.104	.001	-18.90
•	02:00	25	.046	.057	.057	.075	.001	-18.88
•	03:00	25	.037	.058	.062	.094	.001	-18.88
•	04:00	25	.089C	.063	.066	.078	.088C	-18.66
•	05:00	25	.033	.091C	.066	.068	.088	-18.66
•	06:00	25	.025	.063	.090C	.066	.088	-18.66
•	07:00	25<	.022<	.040<	.048<	.085F	.085<	-18.60<
•	08:00	26<	.040<	.043<	.047<	.077<	.001<	-18.87<
•	09:00	25	.056	.056	.057	.078	.001	-18.87
•	10:00	25<	.076<	.076<	.075<	.079<	.001<	-18.88<
•	11:00	25<	.089<	.086<	.084<	.079<	.001<	-18.90<
•	12:00	25<	.089<	.086<	.085<	.081<	.001<	-18.90<
•	13:00	25<	.097<	.093<	.089<	.086<	.001<	-18.92<
•	14:00	26<	.105<	.101<	.099<	.097<	.001<	-18.92<
•	15:00	27	.110	.106	.105	.102	.001	-18.92
•	16:00	27	.113	.111	.109	.106	.001	-18.92
•	17:00	28	.110	.111	.109	.107	.001	-18.92
•	18:00	27	.108	.113	.111	.108	.001	-18.92
•	19:00	26	.082	.101	.103	.109	.001	-18.94
•	20:00	25	.055	.092	.095	.100	.001	-18.94
•	AVERAGE	26<	.071<	.080<	.080<	.089<	.015<	-18.85<



# Multi-Level AQ Monitoring



- SIP AQ Model Verification

# Questions and Comments

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919-715-3743
  - [Wyat.Appel@ncmail.net](mailto:Wyat.Appel@ncmail.net)  
919-715-9773
- NC Air Awareness Program
  - <http://daq.state.nc.us/> ( Follow the links )
  - Call 1-888-RU4NCAIR ( 784-6224 )